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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/660,439	09/12/2000	Toshiyuki Takemori	001155	6603

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EXAMINER

RAO, SHRINIVAS H

ART UNIT	PAPER NUMBER
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2814

DATE MAILED: 09/13/2002

Please find below and/or attached an Office communication concerning this application or proceeding.

10:30 - 9 AM  
11:20 AM  
9 claim 16-

**Office Action Summary**

Application No.

09/660,439

Applicant(s)

TAKEMORI ET AL.

Examiner

Steven H. Rao

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 15 July 2002.
- 2a) ☒ This action is **FINAL**.                      2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 1-19 is/are pending in the application.
- 4a) Of the above claim(s) 12-15 is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☐ Claim(s) 1 and 16-19 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on \_\_\_\_\_ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

**Priority under 35 U.S.C. §§ 119 and 120**

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- \* See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

**Attachment(s)**

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) \_\_\_\_\_.
- 4) ☒ Interview Summary (PTO-413) Paper No(s). 10.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: \_\_\_\_\_.

***Response to Amendment***

Applicants' amendment filed July 05, 2002 has been entered on July 15, 2002. Therefore claims 1,2,6,7,10 and 11 as amended by the amendment and claims 16-19 presently newly added by the amendment are currently pending in the application.

***Election/Restrictions***

This application contains claims 12-15 drawn to an invention nonelected without traverse in Paper No. 9. A complete reply to the final rejection must include cancellation of non elected claims or other appropriate action (37 CFR 1.144) See MPEP § 821.01.

***Claim Rejections - 35 USC § 112***

The following is a quotation of the first paragraph of 35 U.S.C. 112:

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

Claims 17 and 19 are rejected under 35 U.S.C. 112, first paragraph, as containing subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention. Claims 17 and 19 recite that the source region is annular when viewed from a direction parallel to said side surface of said trench , however the specification as originally filed does not describe this element in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention.

The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

Claims 16-19 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claims 16 and 17 recite, " a semiconductor substrate having a semiconductor layer, a drain layer of a first conductivity type formed by diffusing an impurity of the second conductivity type from a surface of said drain layer".

It is not understood how the drain layer can be formed by diffusing an impurity from its ( drain layer's) own surface.

Claims 18 is rejected for failing to further limit from claim 11. Claim 19 is rejected at least for depending upon rejected claim 18.

Appropriate correction is required for all the above rejections.

### ***Claim Rejections - 35 USC § 103***

The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.

Claims 1-11 are rejected under 35 U.S.C. 103(a) as being unpatentable over Baliga ( U.S. Patent No. 5,998,833 herein after Baliga) as previously applied and in view of Sapp (U.S. Patent No. 6,351,018, herein after Sapp).

With respect to claims 1 and 11, Baliga teaches substantially all the limitations recited in claim 11 as previously stated and those stated below.

By the present amendment Applicants' have added the conductive region of second conductivity type ,” formed by diffusing an impurity of the second conductivity type from a surface of said drain layer”.

Baliga in col. 7 lines 1 to 10 states :

to the upper face. The base layer 116 may be formed by implanting P-type dopants such as boron into the drift layer 112 at an energy of 100 keV and at a dose level of  $1 \times 10^{14} \text{ cm}^{-2}$ , for example. The P-type dopants may then be diffused to a depth of  $0.5 \text{ }\mu\text{m}$  into the drift layer 112. An N-type dopant such as arsenic may then be implanted at an energy of 50 keV and at dose level of  $1 \times 10^{15} \text{ cm}^{-2}$ . The N-type and P-type dopants are then diffused simultaneously to a depth of  $0.5 \text{ }\mu\text{m}$  and  $1.0 \text{ }\mu\text{m}$ , respectively, to form a composite semiconductor substrate containing the drain, drift, base and source layers. As illustrated by FIG. 3, the first conductivity

a source region formed of the first conductivity type provided inner surface of said conductive region and exposed on side surface of said trench. ( Baliga fig. 4 H- see below ).

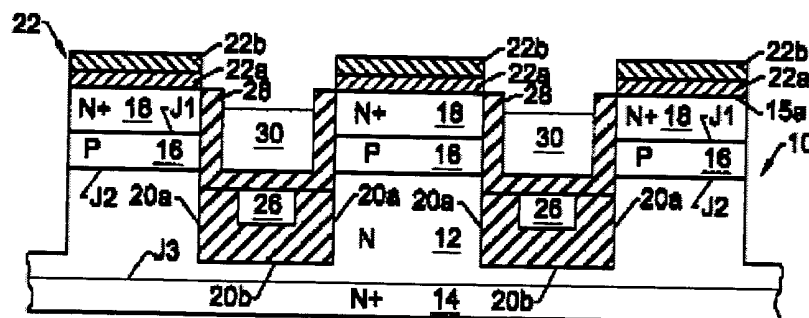


FIG. 4H.

and a gate insulating film provided on the side surface of said trench, " an upper part of the gate insulating film being in contact with a lower part of said source region , a bottom part being in contact with an upper part of said drain layer, and a middle part being in contact with conductive region".

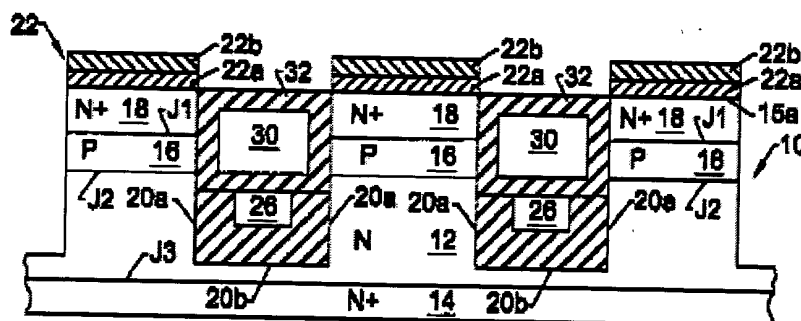
an upper part of the gate insulating film being in contact with a lower part of said source region ( Baliga fig. 4 H , layer 28 in contact with lower part of source 18).

Baliga does not specifically state or describe a bottom part being in contact with an upper part of said drain layer.

However, Sapp in fig. 2 and col. 2 lines 33-45 describes a bottom part of the insulating layer being in contact with upper part of drain region ( col.2 line 43-45) to provide isolation trenches that allow large anode contact area that connects to the trench MOSFET source terminal thus resulting in better devices.

Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to include Sapp's gate insulating film having its bottom part being in contact with upper part of drain region in Baliga's device to provide isolation trenches that allow large anode contact area that connects to the trench MOSFET source terminal thus resulting in better devices. ( Sapp col. 4 lines 60-65).

A middle part being in contact with conductive region ( Baliga Fig. 4 I-see below).



**FIG. 4I.**

a gate electrode material provided in contact with said gate material in said trench. ( see above figures).

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and the insulating material is one of silicon oxide, silicon oxide and PSG, silicon oxide and BPSG or silicon oxide and silicon nitride film. ( co. 10 line 6-silicon oxide, line 22-silicon nitride), and has a thickness of 0.01 to 1.0  $\mu\text{m}$  ( col. 9 lines 53-54 and col. 10 lines 7-8).

With respect to claim 8, to the extent understood, wherein the trench has a mesh on the top surface and the source region is provided in contact with the trench ( figs. 3 and 4).

With respect to claims 9 and 10, to the extent understood, wherein the semiconductor layer is of the first conductivity type or second conductivity type in relation to the opposite type drain layer ( col. 6 lines 35-40).

With respect to claim 11, to the extent understood, Baliga describes a transistor including :

A semiconductor layer having a drain layer of the first conductivity type and an oppositely conductive region of a second conductivity type provided on the drain layer ( col. 6 lines 35-40), a trench extending from a surface of the oppositely conductive region and exposed on an inner circumferential surface of the trench ( fig.2 # area bounded by 120 a and 120b, col. 3 lines 33-40), a source region of the first conductivity type, provided in a trench(fig.2 #126 or fig. 3 # 128a, col. 3 line 39 and col. 7 line 41-42), a gate insulating film provided on the inner surface and bottom surface of the trench so as to reach the drain layer, the oppositely conductive region and the source region. (fig. 2 # 124, col. 3 line 41 and fig. 3 # 125 col. 7 line 60-61), a gate electrode material provided in contact with the gate insulating film (fig. 2 # 126 in contact with 124, col. 3

lines 37-40 and fig. 3 # 128 a in contact with 125, col. 7 lines 40-45), a source electrode film in contact at least with the source region in the trench inner surface and electrically insulated from the gate electrode material (( fig.2 # 118 col. 3 lines 45-50 and fig. 3 # 128b col. 6 lines 51-56). And a metal film formed on a surface of the drain layer opposite to the oppositely conductive region to establish Schottky contact with the drain layer ( col. 11 lines 14-19).


Any inquiry concerning this communication or earlier communication from the examiner should be directed to Steven H. Rao whose telephone number is (703) 306-5945. The examiner can normally be reached on Monday- Friday from approximately 7:00 a.m. to 5:30 p.m.

Any inquiry of a general nature or relating to the status of this application should be directed to the Group receptionist whose telephone number is (703) 308-0956. The Group facsimile number is (703) 308-7722.

  
Steven H. Rao

Patent Examiner

April 01, 2002.

  
Jerome Johnson, Jr.  
Patent Examiner